

Substitute Specification - Clean Version

WHAT IS CLAIMED IS:

1. Method for the catalytic reduction of an amide for the preparation of an amine at a temperature of below 200°C and a pressure of below 50 bar, the catalyst being chosen from bimetallic and trimetallic catalysts of the group consisting of ABC, AB, AC and BC, wherein:
A is a metal selected from the group consisting of Co, Fe, Ir, Pt, Rh and Ru,
B is a metal selected from the group consisting of Cr, Mo, Re and V, and,
C is a metal selected from the group consisting of Cu, In and Zn.
2. Method according to claim 1, wherein the catalyst is a heterogeneous catalyst on a support.
3. Method according to claim 2, wherein the support is selected from the group consisting of carbon, silica, titania, silica-alumina or a combination thereof.
4. Method according to claim 1, wherein the pressure is 30 bar or less, preferably 15 bar or less.
5. Method according to claim 4, wherein the pressure is between 1-17 bar, preferably between 5-10 bar, most preferably between 6-10 bar.
6. Method according to claim 1, wherein the reduction is performed in continuous flow mode, preferably in a gaseous phase.
7. Method according to claim 1, wherein the temperature is 160° or less.
8. Method according to claim 7, wherein the temperature is 130°C or less.
9. Method according to claim 8, wherein the temperature is between 70°C-100°C, preferably around 80°C.
10. Method according to claim 1, wherein the reduction is performed in batch

Substitute Specification - Clean Version

mode, preferably in liquid phase.

11. Method according to claim 10, wherein the amide is dissolved in a Bronsted-acid.
12. Method according to claim 11, wherein the Bronsted-acid is an organic acid.
13. Method according to claim 12, wherein the organic acid is a carboxylic acid.
14. Method according to claim 13, wherein the carboxylic acid comprises acetic acid.
15. Method according to claim 11, wherein the Bronsted-acid has a pKa value of 5 or less, preferably between 3 and 5.
16. Method according to claim 11, wherein the concentration of the Bronsted-acid being 1.0 M or less, preferably between 0.2 and 0.8 M, more preferably between 0.4 and 0.5 M.
17. Method according to claim 10, wherein the liquid phase comprising an additive comprising a Lewis acid.
18. Method according to claim 17, wherein the Lewis acid comprises a Boron compound.
19. Method according to claim 17, wherein the ratio amide:additive is 4 or less, preferably 2 or less, most preferably between 0.9 and 1.1.
20. Method according to claim 10, wherein the temperature is between 90-140°C, preferably 100-130°C.
21. Method according to claim 1, wherein the catalyst is selected from the group consisting of CoCu, FeIn, FeRe, IrMo, IrRe, IrV, MoIn, PtMo, PtRe, PtrV, ReIn, RhCu, RhIn, RhM, RhRe, RhV, RuRe, CoMoZn, CoReCu, CoReIn, CoVIn, FeCrIn, FeReCu, FeReIn,

Substitute Specification - Clean Version

FeReZn, IrMoCu, IrReCu, IrReZn, IrVZn, PtMoCu, PtMoIn, PtMoZn, PtReCu, PtReIn, PtReZn, PtVIn, PtVZn, RhMoCu, RhMoIn, RhMoZn, RhReCu, RhReIn, RhReZn, RhMoZn, RhVIn, RuReCu, RuReZn and combinations thereof.

22. Method according to claim 21, wherein the catalyst is selected from the group consisting of IrMo, IrRe, PtRe, PtV, RhRe, RhV, FeReIn, PtReCu, PtReIn, PtReZn, RhMoCu, RuReZn, PtMo, RhMo, RuRe, IrReZn, PtMoCu and combinations thereof.

23. Method according to claim 22, wherein the catalyst is selected from the group consisting of IrReZn, PtReCu, PtReIn, FeReIn, PtMo, PtV, RhMo, PtMoCu, RhMoCu, PtRe, RuRe and combinations thereof.

24. Method according to claim 23, wherein the catalyst is selected from the group consisting of PtReCu, PtRe, PtMo IrReZn, PtMoCu, PtReIn and combinations thereof.

25. Bi- or trimetallic catalysts for the reduction of amides to amines, wherein the catalysts are selected from the group consisting of CoCu, FeIn, FeRe, IrMo, IrRe, IrV, MoIn, PtMo, PtRe, PtV, ReIn, RhCu, RhIn, RhV, CoMoZn, CoReCu, CoReIn, CoVIn, FeCrIn, FeReCu, FeReIn, FeReZn, IrMoCu, IrReCu, IrReZn, IrVZn, PtMoCu, PtMoIn, PtMoZn, PtReCu, PtReIn, PtReZn, PtVIn, PtVZn, RhMoCu, RhMoIn, RhMoZn, RhReCu, RhReIn, RhReZn, RhMoZn, RhVIn, RuReCu, RuReZn and combinations thereof.

26. Bi- or trimetallic catalyst according to claim 25, wherein the catalyst is selected from the group consisting of IrMo, IrRe, PtRe, PtV, RhV, FeReIn, PtReCu, PtReIn, PtReZn, RhMoCu, RuReZn, PtMo, IrReZn, PtMoCu and combinations thereof.

27. Catalyst according to claim 26, wherein the catalyst is selected from the group consisting of PtReCu, PtRe, PtMo IrReZn, PtMoCu, PtReIn and combinations thereof.

28. Method for the selection of at least one bi- or trimetallic catalyst, active in the reduction of amides into amines, from a collection of bi- and/or trimetallic catalysts, comprising the steps of:

- A) preparing the catalysts on separate carriers,
- B) loading the catalysts prepared in step A) in separate reactor vessels, the vessels

Substitute Specification - Clean Version

having a parallel arrangement,

- C) feeding and incubating the reactor vessels with an amide and hydrogen at identical conditions regarding at least one of the quantities, chosen from reaction time, temperature and pressure,
- D) measuring the conversion of amides into amines in each reactor vessel, and
- E) selecting one or more of the catalysts, based on the measured conversion in step D).

29. Method according to claim 28, wherein in step C) the reaction time, temperature and pressure in the reactor vessel are similar for each reactor vessel.

30. Method according to claim 28, wherein in step A) the catalysts are prepared on separate carriers in parallel.

31. Method according to claim 28, wherein in step C) the reaction vessels are fed in parallel.